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ABSTRACT

An examination of definition, causes, variables, and strategies of implementation suggests the kinds of data necessary for measuring school effectiveness. By focusing on students who first enter school below grade level standards and by understanding that student learning is embedded in a system of key elements or variables that, over time, are interrelated in a circular pattern of causality, longitudinal research provides such data on effective schooling. Essential structural differences between effective and ineffective schools are highlighted by causal loop diagrams illustrating both key variables and the concept of circular causality. The variables, which identify areas requiring further empirical research, are teacher effectiveness and expectations, time allocated to instruction, engaged learning time, and student motivation, behavior, and achievement. The variables identify points of intervention in the system where the principal's leadership role is critical in achieving an effective school. After the problem has been defined, causes understood, and points of intervention identified, a theory of implementation is required. The authors thus emphasize the need for research on the organizational dynamics of implementing school effectiveness programs. (PB)

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MEASURING SCHOOL EFFECTIVENESS: A SYSTEMS PERSPECTIVE

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Paper Presented at the Annual Meeting of the
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MEASURING SCHOOL EFFECTIVENESS: A SYSTEMS PERSPECTIVE

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The opening remarks for this Symposium highlight the current dilemmas in measuring school effectiveness. These stem from the two central issues in measurement -- what to measure and how to measure it. Thus, the purpose of this symposium is to focus attention on each of these issues in hopes of resolving some of the dilemmas in the research and practice of school effectiveness.

We shall speak, from the perspective of our own work, about what empirical data are required to advance theoretical understandings about effective schooling and to support the successful implementation of school improvement programs. We speak as theoreticians whose efforts have involved knowledge synthesis, theory building, computer simulation modeling, and policy analysis. We have approached the question of what to measure by examining four related questions in four different areas:

THE NATURE OF THE PROBLEM	What is an effective or ineffective school and what data must one have to assess the relative effectiveness of a particular school?
THE CAUSES OF THE PROBLEM	What are the limitations in the literature with respect to understanding why schools are persistently ineffective and what data collection and analysis are needed?
"ALTERABLE" VARIABLES	What are the most potent points of intervention for improving schools and what are the most appropriate kinds of baseline data to collect?
STRATEGIES FOR IMPLEMENTATION	What are the most significant factors that interact to enhance or inhibit the implementation of school improvement programs and what data are necessary to measure the current levels of these variables?

These questions raise broader issues of definition, theory, and fact -- issues which are closely intertwined. Definitions are rooted in values. Theories configure defined concepts according to logical rules and known facts. Facts derive from empirical research which, in turn, relies for direction upon existing theory. Facts also depend on the science of measurement, rooted in epistemology and technology. Methods of research design and data analysis represent procedural manifestations

of the logic of knowing.

It is not our intent here to focus discussion on these broader dimensions of the problem of ineffective schooling. Rather, we acknowledge that our perspective on these meta-issues shapes our thinking and our conclusions. In the pages that follow, we shall outline our own thinking about each one of the four questions put forth above and try to make our assumptions clear. The central focus of our remarks will be on what data are necessary for measurement. We will leave to others whose work focuses more directly on these matters discussion of the technical issues of how to measure.

Defining the Problem

The first question we shall address relates to how one defines the problem of school effectiveness. We have adopted a systems perspective in approaching the issue of definition. Taking this perspective means that we view problems in organizations as problems that are discrepancies over time between actual organizational behaviors and some desired set of behaviors. For example, in studies by the Connecticut School Effectiveness Project of less effective schools, the desired behavior is that the same fraction of middle-class and disadvantaged children score above the 30th percentile on standardized math and reading achievement tests; the actual behavior is that the fraction of disadvantaged children is far lower; and the problem discrepancy is the gap between what the value of the fraction is and should be. It is this discrepancy that the State of Connecticut is trying to close.

One of the issues in defining a problem in school effectiveness is deciding what the desired behaviors should be and, therefore, what the problem discrepancy is. This is not an easy task since the decision is ultimately rooted in values. The second issue revolves around how one looks at the discrepancy. It is important to recognize that a problem in student achievement patterns is a longitudinal problem. An ineffective school does not become ineffective instantaneously. The roots of ineffectiveness cannot be traced to an isolated event. We see the problem as being generated over time by the structure of the system. It is a systemic problem. That is, patterns in student achievement are the result of patterns of student-teacher interactions that tend to become established when a child enters the school and then persist from grade to grade. In an ineffective school, if a child starts out below grade level, he gets labelled a "low achiever" and patterns of instruction are set in place that result in his falling further and further behind as he moves from grade to grade. The discrepancy measured in the sixth grade has its roots in patterns established in the first grade.

So our systems perspective on school effectiveness problems is that these problems are longitudinal in nature and that they are defined in terms of discrepancies between what is and what should be. If researchers and practitioners agree that the problem is fundamentally a longitudinal problem, then we seriously question the use of essentially static and cross-sectional measures of school achievement -- whether they be average scores, average gains, average passing rates, or these metrics differentiated by group.

By contrast in our own research, we formulated what might be called the "radioactive tracer" technique for measuring school effectiveness. Radioactive tracers are used in biology and medicine to monitor the functioning of an organism over time. The tracers are injected into the organism and, at selected time intervals, the organism is scanned with a radiation detector to determine where the tracers are. Analysis of the data over a number of time intervals reveals longitudinal patterns that provide insights into the relative health of the organism or the functioning of a particular part of the organism.

In our school effectiveness research, the organism is the school, the tracers are selected groups of students, and the radiation detectors take the form of measures for tracking changes over time in behavior, motivation, instruction, and learning. A school is perceived as effective to the extent that the achievement pattern for each tracer group equals or exceeds the normal achievement pattern (i.e., students being on grade level and gaining at least one year per year).

For us, the focal group of concern is comprised of those students who are, when they first enter school, initially below grade level standards. We focus on these students because the literature shows that a disproportionate number of these students are poor and/or minority children and because our research shows that less effective schools tend to reinforce these initial achievement patterns. Thus, as students move from grade to grade, the initially high achievers continue to excel, the initially average achievers continue to do average work, and the initially low achievers fall further and further behind grade level standards. By contrast in the effective school, the gap between grade level standards and the achievement pattern for initially low achievers narrows and closes as the students move through school.

It must be said that the current state of knowledge about effective schooling is a strange one, indeed. There is general agreement that the problem of the widening gap in learning between grade level standards and initially low-achieving students is a credible reality in most schools. What we have not been, however, is solid documentary evidence to describe the precise nature of these trends in schools. What is still needed are widespread longitudinal studies of children in diverse school settings who are identified on the basis of initial school entry characteristics and who are followed systematically over a number of years of schooling. It is important to describe not only the shape of achievement patterns by cohort but also the persistence of such patterns in particular schools over significant periods of time. We need to know more about the magnitude of these learning gaps and their variations within and across schools over time. Thus, in the broadest sense, we recognize that it is essential to have available through empirical research the longitudinal measures by which the problem, itself, can be documented.

Clearly, this data condition needs to be rectified in large scale studies geographically dispersed across the country. Some efforts, in the State of Connecticut for example, are being made to implement the requisite studies and to develop appropriate procedures and instruments, but we believe that many systematic efforts need to be funded in many states. Undoubtedly, the sharing of approaches to instrumentation is crucial if these efforts are to be carried out in ways that are efficient and comparative. [1]

Understanding the Causes of the Problem

A systems perspective that begins with defining organizational problems as discrepancies that persist over time naturally leads to asking why these problems persist. Problems of this type are unlikely to have their root causes in isolated external events. Rather, their causes are rooted in the structure of the system. Understanding why a problem persists means, for us, understanding the structure of the problem system -- a system which might encompass both "organizational" and "environmental" variables. [2]

The second question evolves from efforts to gain an understanding of why schools are persistently ineffective or effective. In our own research we reviewed the current literature in order to construct a causal theory of school effectiveness and to translate that theory into a computer simulation model for policy analysis. In the process, we found areas in the literature where research findings were either contradictory or non-existent. We believe that further empirical research is needed in these areas to help illuminate and advance a theoretical understanding of the dynamics of school effectiveness. The following paragraphs briefly summarize the theory and then address the implications for research that we see arising from our efforts in theory-building and modeling.

Background. In the school effectiveness problem, we see the structure of the system as being a set of key variables (e.g., time allocated to instruction, engaged time, teacher expectations, teacher

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[1] The Northeast Educational Exchange (NEREX) is currently supporting multiple efforts in the Northeastern states in the form of what are being called School Improvement Institutes. It is the purpose of these institutes to facilitate collaboration among local school districts, universities, and other agencies for school improvement. These institutes are supporting, among other things, the development, testing, and transfer of procedures and instruments for evaluating various dimensions of effective teaching and schooling. This effort is illustrative of the kinds of efforts proceeding nationally with respect to improving the effectiveness of schools for all kinds of students.

[2] On Friday, April 15, at Session 57.09, we are presenting another paper which directly addresses this issue. The paper is entitled "Organizations and Their Environments: A System Dynamics Perspective."

effectiveness, student motivation, student behavior, and student achievement) that mutually interact day-in and day-out through a network of causal relationships to produce the patterns in student achievement and school processes that are characterized as more or less effective.

The essential systems idea here is that student learning is embedded in a system of elements which, over successive periods of time, are interrelated in circular patterns of causality. Thus, student achievement is not simply a "dependent" variable but an element in a network of circular causality. It is affected by other variables but it also has a return effect on those variables. Instruction, motivation, and behavior respond to variations in student achievement just as the contrary is true.

This idea of circular causality differs from most traditional research which has tried to discover what factors "affect student learning." The implication in traditional research has been that these "independent" variables cause variations in student learning, which typically has been perceived as the "dependent" variable. Causation is assumed to be in one direction only and path models are characteristic representations of this way of thinking.

The Theory. Our approach to developing a theory of school effectiveness has been to construct a circular theory of causality that links student variables with organizational and instructional variables. The purpose of this section is to present a brief overview of this theory of school effectiveness as a context for discussing the deficiencies we found in the literature and making some suggestions about the kinds of data that might be collected to erase these deficiencies. [3] The diagrams presented below, called "Causal Loop Diagrams," graphically illustrate the key variables and the concept of circular causality. They also highlight the essential structural differences between schools that are effective and ineffective for initially low-achieving children.

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[3] The following works offer a more detailed explication of the theory and the model: Clauset, 1982; Clauset and Gaynor, in preparation; Clauset and Gaynor, 1982a,b.

The first diagram (Figure 1) illustrates the basic feedback structure for an effective school. [4]

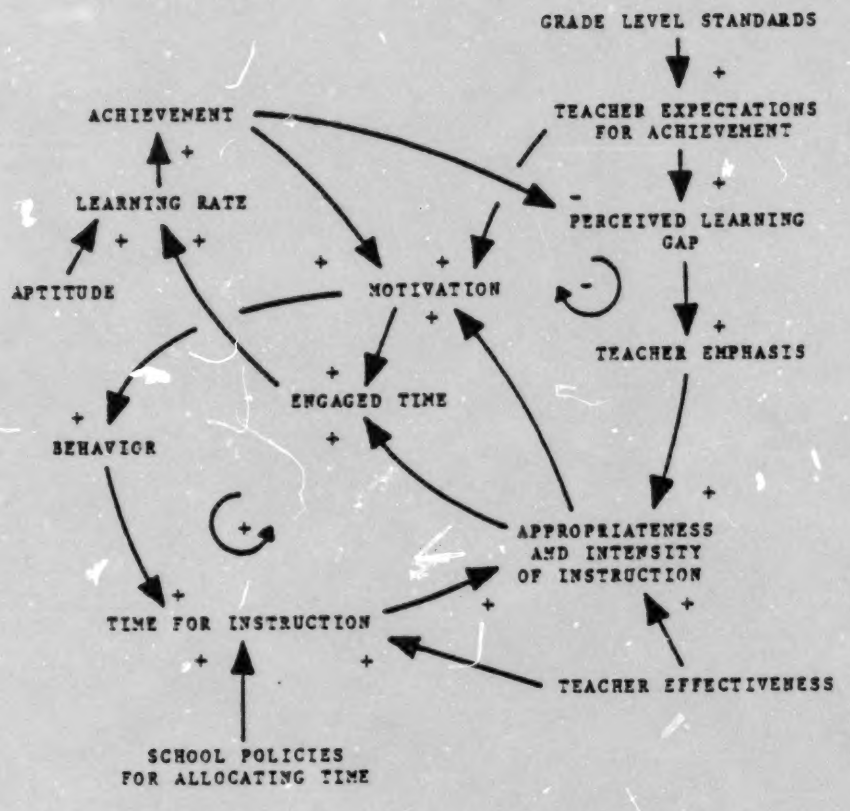

Figure 1. The Basic Feedback Structure in an Effective School

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[4] In the figure, the plus and minus signs on the links between variables indicate the nature of the relationship (i.e., direct or inverse). For example, a plus sign between achievement and motivation means that as achievement increases, motivation will also increase and as achievement decreases, motivation decreases. The minus sign between achievement and perceived learning gap means that as achievement falls, the perceived learning gap becomes larger and as achievement rises, the gap becomes smaller. The arrowheads on the links between variables indicate the direction of causation.

The causal relationship shown between achievement and instruction is consistent with the BTES research in California on achievement, learning rate, and academic learning time (Fisher, et al., 1978). [5] Appropriateness and Intensity of Instruction directly affects the amount of engaged time. It also affects student motivation as children compare the instruction they receive with that given to others and as they are affected directly by instruction which is more or less stimulating to them. Motivation to learn is, in addition, influenced by the child's perception of the teacher's expectations for him and by his awareness of his achievement relative to grade level standards (cf. Kolesnik, 1978).

The level of appropriateness and intensity of instruction for a given achievement group is dependent on the amount of time for instruction in the subject, the teacher's effectiveness, and the amount of emphasis the teacher places on the group. Time for instruction is a function of: (1) school policies for allocating time among subjects and for allocating time between instructional and non-instructional activities (assemblies, lunch, recess, etc.) and (2) time the teacher must spend dealing with classroom behavior problems. Time spent on behavior problems depends on the level of student behavior in the class, the teacher's effectiveness, and the impact of the behavior of other students in the school. Teacher effectiveness refers to both the teacher's instructional and classroom management skills. Effectiveness is mediated by class size, although more highly skilled teachers are less affected by larger and more able to take advantage of smaller class size.

The third component of appropriateness and intensity of instruction is the amount of emphasis a teacher gives to a particular achievement group. In heterogeneous classes, this emphasis is a function of a teacher's desired emphasis and the competing demands of other groups. It is central to our theory of schooling that the perceived learning gap

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[5] Partly for purposes of simplification, we chose in constructing the model to assume equal "native learning ability" for all children in the simulated elementary school. Clearly, this is not likely to be precisely true; however, a fundamental part of our thesis is that it is more true than would appear by deduction from the variance in actual achievement scores. An important purpose of our modeling effort was to demonstrate theoretically that results very similar to those obtained historically in real schools (i.e., in terms of the divergence in achievement scores) could be accounted for without assuming differences in native ability. What was assumed in the model is that students differed in their entry achievement (i.e., "learning readiness"). We offered no interpretation with respect to the causes of those initial differences, neither hereditary nor environmental. We have simply hypothesized, on the basis of what we believe to be reasonably compelling evidence, that many children are capable of learning far more in school than they do and that learning is importantly a direct effect of the appropriateness and intensity of instruction (Bloom, 1976; Fisher, et al., 1978).

between teacher expectations and the level of achievement is a major determinant of teacher emphasis. A teacher will devote more emphasis to a particular achievement group if the teacher perceives a gap in achievement. If there is no gap between expectations and achievement, there will be no effort to increase the emphasis for a particular group. In the effective school, expectations are based solely on standards and not on past achievement. Consequently, there is a significant gap in achievement for the initially low achievers and teachers want to place more emphasis on these students to raise their achievement.

In systems terms, the basic driving force in the effective school structure is a negative feedback loop which operates to control the level of student achievement by adjusting the appropriateness and intensity of instruction. The goal of this control system is to close the discrepancy between teacher expectations (which are based on fixed standards for all children) and student achievement.

The school which is ineffective for initially low-achievers is driven by a different causal configuration (Figure 2). This difference may not be immediately apparent to the reader. Actually, the two structures are identical except that teacher expectations are no longer based on a fixed set of achievement standards.

For low achieving students in the ineffective school, teachers' expectations respond directly to student achievement. This is the essence of the ineffective school. Students who do poorly are expected to do poorly. Thus, from the teacher's perspective, there is no sense of a learning gap, no need to alter the nature of instruction, no ownership of an instructional problem, and no motivation to work at improving teaching skills. In essence, "The kid can't learn, or doesn't want to. It's his problem, not mine."

The effect of directly linking teacher expectations and student achievement in the ineffective school is to collapse the negative feedback loop which operates in the effective school to control the level of student achievement. What now dominates the system is a positive feedback loop which reinforces existing achievement patterns. It works well enough for students who are above average in achievement when they enter school. The system works to reinforce their motivation, their behavior, and ultimately their further achievement. However, for students who enter school with poor readiness skills, this "multiplier system" works to depress their motivation to learn, to reinforce dysfunctional behavior patterns of "acting out" or withdrawal, to reduce teacher emphasis on them, and to further diminish their future achievement. Thus, instruction becomes less appropriate and intense in response to declining achievement.

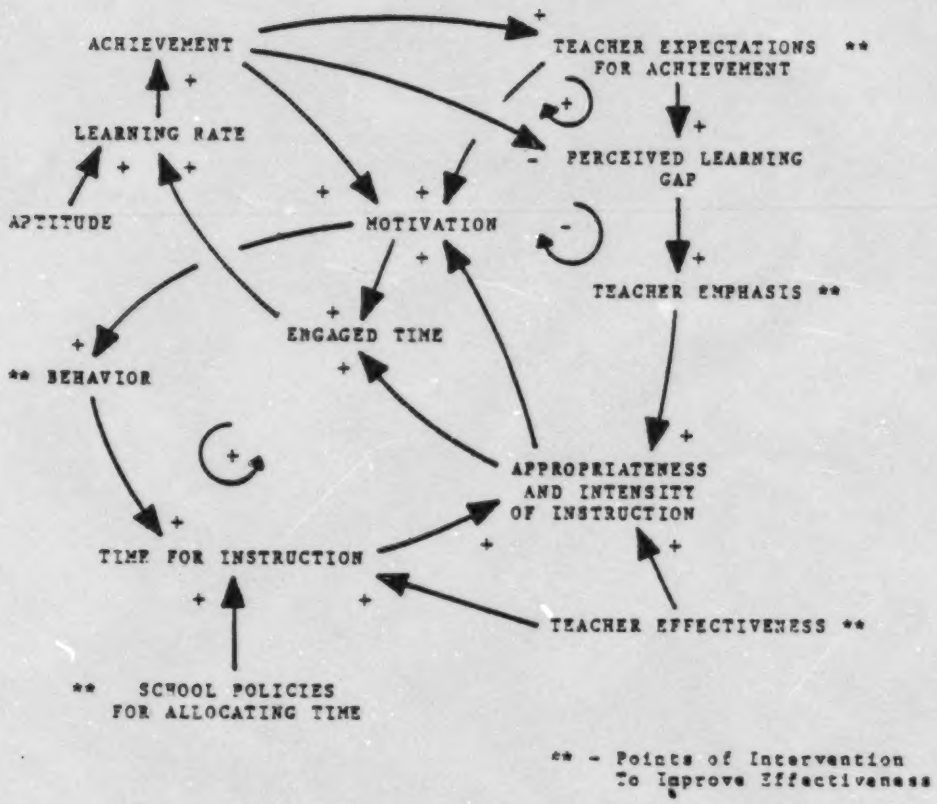

Figure 2. The Basic Feedback Structure and Points of Intervention in an Ineffective School

The Theory and the Role of the Principal. It may have occurred to the reader that the theory described above makes no reference to the school principal. In a sense, there appears to be no principal in the school. How can this be?

There are two ideas behind this that are important to describe. The first is that there are two quite different ways to think about a school principal. One is to think of the principal as a role-incumbent, a member of the bureaucracy who appears on the table of organization of the school district. Another is to think of the principalship as a set of functions to be performed. The person is important only in terms of what he or she does.

In formulating the theory, we have taken the second perspective. From this perspective, the principal is someone who performs leadership functions. However, the principal is not necessarily the only person who performs leadership functions. Indeed, in viewing the school as an effective operating institution, it is not essential to describe "a principal" but only to understand that certain leadership functions will be performed by someone or by some set of people. What, then, are these leadership functions?

In Parsons' classic terms, leadership is responsible for the organization's performance of four "imperative functions": integration, pattern maintenance, adaptation, and goal attainment (Hills, 1968). In systems terms, we have interpreted that to mean that leadership is responsible for creating the structures that make possible the performance of essential functions. Thus, leadership is responsible, by definition, for implementing policies that, if necessary, alter the structure of the organization in ways that enhance its ability to perform these functions effectively and efficiently.

This description of the role of leadership in an organization is, we believe, consistent with traditional definitions of leadership in the management literature. Based on a cybernetic theory of management, the literature defines a control function for leadership. Control is generally thought of, at least implicitly, as a normative function coincidental with leadership. That is, it is seen as related to the "goals" of the organization, whose attainment is the special responsibility of leadership. Consistent with the etymological roots of the term "cybernetics" (from the Greek meaning "helmsman"), control is a leadership function which involves "steering" the organization toward goals which are rooted in values. [6]

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[6] To avoid any possible misunderstanding, it seems appropriate to establish certain demurrers about the implications which might be associated in the reader's mind about the word, "control." First, it carries no implications for us with respect to any particular sort of "leadership style." While for some, it may have connotations of directiveness or authoritarianism, it can just as well imply participativeness of even the most collegial or communal proportions. Second, it begs the question of goal consensus. In the previous text, we used "goals" in quotation marks in order to suggest the problematics associated with their conceptualization in an organizational context. We recognize the political implications of goalsetting in practical social situations and the cui bono issues it raises (cf., Clegg and Dunkerley, 1980, chap. 8). In reality, the concept of control has no meaning except as it relates to goals, and the definition of organizational goals turns out empirically and philosophically to be highly problematic. However, this is an issue for another symposium.

In the diagram of our theory of schooling (Figure 2), we have indicated several potential points of intervention. These points represent entry points for exerting control over the teaching-learning process. Pressure for leadership action arises from a discrepancy between the actual level of a variable, such as teacher expectations, and a more desirable level. This action results in the implementation of policies designed to bring the actual level of the variable closer to the desired level. This process exemplifies the control function (or loop) in actual operation. The implementation of such control processes implies the existence of policy-driven control structures through which the organization perceives and responds to undesirable discrepancies. Such control structures are made explicit by systems analysts by diagramming negative feedback loops which describe the perception-response dynamics.

Implicit in the fact that we have not shown these control loops in the diagram is the idea that, in the ineffective school, the desired levels for teacher expectations, teacher emphasis, teacher effectiveness, student behavior, and time for instruction are the same as the current levels and there is no active structure for perceiving and responding to a problem. Thus, there is no discrepancy and no pressure from the leadership for change. The "principal" is there, but he or she is, de facto, entirely in agreement with the status quo. In the improving school, there is a perceived discrepancy between actual and desired levels and the leadership exerts pressure for change. The control loop begins to operate. When we began our policy analysis of the relative effectiveness of interventions at these different points, our first step was to construct explicit control loops for each variable.

Control has, in addition to the normative features described above, a generic aspect in social systems. Social systems can have "goals" which are not necessarily those of "leadership" but which are embedded in the sedimented historical structure of these systems. Such goals may often be covert (in the sense of "unnoticed") but they are potentially describable and can often be powerful, even perverse. It is our theoretical position that normative control (i.e., leadership) always operates in an organizational context marked significantly by generic control structures which describe the historical tendencies of the social system to seek certain natural goal states over time.

An example of this conflict can be found in our theory of schooling. The level of student behavior is fundamentally driven by student motivation and perceptions of success in learning. It is generically controlled by these variables. Interventions by the principal or teachers to change behavior directly represent normative controls. We argue that normative interventions to improve behavior without improving instruction will be met with resistance (by the generic control structure based on learning and motivation) and will, over time, have negligible, or even detrimental, effects.

It is our intent as we proceed with our theoretical work, and with the empirical forays necessary to direct it, to do two interrelated things: (1) to describe the generic goal structures of schools and (2)

to examine what policies might assist leadership in its quest to have normative ends prevail over undesirable generic ends. Modally, "leadership" in schools signifies the school principal. Thus, as we examine policy options for transforming relatively ineffective schools into relatively effective ones we discover that "the principal" is in the theory, after all, and that our policy analyses give shape and substance to the set of critical leadership functions he or she performs.

From Theory to Simulation Model. In our research we were interested both in developing a causal theory of schooling and in using the theory to evaluate the likely consequences of various school improvement policies. To accomplish the policy analysis, we translated our theory into a computer simulation model. [7] There are several advantages to computer simulation modeling. It enables one to test the internal consistency and robustness of one's theory in a manner which is impossible with mental models. Furthermore, the model allows one to search systematically for important policy levers in the problem system and then to test a range of potential policy solutions for ameliorating the problem. One can evaluate the likely consequences of different policies before investing large amounts of time, money and human resources on a particular policy option in a real school or school district.

The final advantage lies in the nature of the process. To write a set of mathematical equations for computer simulation, one must be explicit about one's assumptions and the relationships among system variables. The process draws on the existing research literature and on the experiential, qualitative knowledge of practitioners. It encourages dialogue and debate about assumptions and relationships. The process is iterative. Trying to write equations to express a relationship may force one back to the literature for more information or may force one to reconceptualize the relationship completely. It is this circular process of moving between the knowledge base, the theory, and the simulation model that leads to deeper understanding of the problem and to a realization of those areas which require further research. [8]

Implications for Research. Having taken time to define our sense of the problem, our perspective, and the nature of our work, we now come to what we believe are the implications of our theoretical work for the

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[7] The method we used for building the computer model was System Dynamics. System Dynamics is a particular form of systems analysis which was developed at M.I.T. during the late 1950's and has been refined in a variety of applications over the last quarter century. It includes a set of tools and techniques for developing computer simulation models of dynamic causal structures. For a more detailed introduction to System Dynamics see Forrester (1968) or Richardson & Pugh (1981).

[8] Despite its incorporation of computer technology, this approach appears analogous conceptually to the so-called "hermeneutic circle" (see, for example, Sergiovanni, 1982, pp. 75-76).

development of a sound research agenda with respect to improving schools for low-achieving children. Obviously, the nature of this agenda will suggest the nature of the measurement problems which are likely to be encountered. What is required is an ongoing program of iterative research and theory building. It is clearly not enough to go forward with pieces, even programs of empirical research without also investing in ongoing programs of knowledge synthesis which systematically integrate accumulating research findings and guide further empirical study.

Dynamic modeling is a knowledge synthesis and theory building tool which requires several different types of decisions and information. It requires longitudinal data about the problem behaviors of interest (such as patterns of student achievement) in order for the model builder to determine whether the model produces reasonable and realistic behaviors. In the previous section on "Defining the Problem," we described the kinds of data that we think are necessary for developing these reference behaviors. Modeling also requires decisions about which variables to include and which variables to leave out of the model. In the field of systems analysis, these are called decisions about "model boundaries." It seems essential to us that all serious empirical work be rooted in theories which are very clear about hypothesized model boundaries and causal paths (i.e., what system dynamicists call "causal-loops"). For example, it is well known to research methodologists that no meaningful statistical interpretation of data can be made without a clearly explicated theoretical structure as a point of analytic reference (James, et al., 1982; Pedhazur, 1982, Chaps. 8-9).

Once the model boundaries have been set, one must make decisions about which factors to treat as constants and which to include as variables. Model specification also requires information about the precise nature of the causal relationships among variables. For example, consider the relationships among teacher effectiveness, time available for instruction, and engaged time. Engaged time will be some fraction of the total time available for instruction. This fraction clearly depends on the teacher's effectiveness (skills mediated by class size, workload pressures, and commitment). If a teacher has "average" effectiveness and an "average" class, what fraction of time available for instruction is translated into engaged time? If teacher effectiveness is above or below average, how will the fraction change? Is the relationship between effectiveness and fraction of time engaged a linear relationship? Are there maximum or minimum values (other than 0 and 1) for the fraction? These are the kinds of questions modelers must ask of the literature in seeking to translate general theory into highly detailed computer models. The BTES work and Stallings' research (c.f. Stallings, 1980) are just beginning to shed some light on these questions.

Other questions revolve around setting initial parameters, such as the average length of the school day or the average amount of faculty release time for in-service, or around determining the time it takes for one variable to change in response to a change in a second variable (e.g., in an ineffective school, the time it takes for teacher expectations to move toward observed student achievement).

In the following paragraphs we describe some of the areas where we felt the literature was not specific enough to provide detailed information about the precise nature of the parameter values or the causal relationships among variables. These knowledge gaps imply the need for empirical research to provide further relevant information.

There are five major areas in the literature where we found deficiencies:

- o time, learning, and achievement
- o student motivation and behavior
- o teacher expectations
- o teacher decision-making for instruction
- o teacher effectiveness

TIME, INSTRUCTION, AND ACHIEVEMENT

We found in the literature a widespread recognition of the importance of time as an instructional variable. Time in our theory and computer simulation model is the central medium of instruction. For example, the theory concerns itself with instructional vs. non-instructional time and with the distribution of instructional time among subject areas and achievement groups. Skilled teachers are viewed as those who use time more effectively and efficiently. Disruptive student behavior takes time away from instruction. More motivated students are engaged in learning for higher proportions of time than less motivated students. The learning rate is a direct function of engaged time.

A concern about time as an instructional variable has raised several issues for us. The first issue is a normative one. What are "normal" time allocations in elementary schools? How long is the average school day? What fraction of the school day is spent in the classroom? In non-instructional activities? How is time usually apportioned among subjects?

A second issue centers around the relationship between engaged time and learning rate. The behavior of our computer simulation model has raised questions about the nature of this relationship. In the model, the learning rate and, therefore, student achievement is quite sensitive to policy interventions which affect time for instruction. It seems to us that the sensitivity of the learning rate to variations in engaged time is substantially more marked than our own experience in schools would suggest and that real schools are substantially more "loosely coupled" with respect to time than the simulated school. We have been puzzled by this, particularly since the model behavior in other ways is consistent with common experience and research.

This apparent discrepancy between real behavior and model behavior raises for us a number of questions which empirical research might seek to answer. What is the modal relationship in public schools between clock time and engaged learning time? Is this relationship "loosely coupled" in the sense that variations in clock hours are compensated for in classrooms so that there is in real schools little correlation between the two? If so, how does this occur: i.e., what norms and structural dynamics govern the compensation mechanism? To what extent are student turnover and absenteeism (variables not included in the model) factors in the compensation dynamic? How much engaged time (i.e., academic learning time) does it take to produce a "normal" year's growth in reading or mathematics? To what extent is this relationship variate with respect to stable (i.e., unalterable) individual or cultural characteristics or to grade level?

A third issue focuses on what might be called a saturation effect on engaged time. Schools can attempt to raise significantly time on task, but at what point does the law of diminishing returns begin to take effect so that further increases in time on task do not lead to corresponding gains in engaged time and learning?

A fourth issue relates to the impact of the student's past achievement on his/her present learning rate. We take the theoretical position that the student's prior achievement can enhance or impede present learning in the same subject and that the level of reading achievement can affect learning in other content areas as well. We have also incorporated the assumption that these effects are mediated by the quality and quantity of instruction the student receives. While there is some research on this issue (c.f. Bloom, 1976), we believe more is needed to specify more precisely the nature of this relationship.

STUDENT MOTIVATION AND BEHAVIOR

Another area of concern is student motivation and behavior. In our theory, student motivation and behavior are important factors which enhance or constrain the learning process. Good behavior and high motivation increase time available for instruction and engaged time for learning. Disruptive behavior and low motivation work against teacher efforts to improve instruction. In the process of developing equations that linked motivation, behavior, and learning, we focused on questions such as: What are the determinants of behavior and motivation to learn? What are the relative strengths of these determinants and do the determinants and their strengths vary with grade level? For example, how important are friendship patterns and peer relationships and how do these change developmentally over time? [9] How fast does a student's

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[9] The School Effectiveness Model relates a student's behavior (in order of descending impact) to the motivation and behavior of his peer group, the average level of behavior of the class, and the level of schoolwide behavior. Overall schoolwide behavior is most affected by older children and least affected by younger children. For a fuller discussion of dynamic relationships between academic achievement and peer choice, see Gaynor (n.d.).

motivation or behavior change in response to a change in one of these determinants? How does school-wide behavior affect the behavior of students in a particular class? How does classroom behavior affect the school? Do the effects vary with grade level? Is the effect of the behavior of a group of students on a class proportional to its relative size? Is there a "critical size" above which a group's disruptive behavior has a disproportionate effect? We found no clear consensus in the literature on these questions and we hope that more empirical research can be conducted in this area.

A related issue that concerns behavior is whether it makes sense to view disruptive behavior as a cause of ineffective schooling or as a symptom. In our theory, behavior is a manifestation of the problem -- an outcome that can feed back into the system to have detrimental effects. Disruptive behavior is driven by failure in school. From this perspective, school improvement efforts that improve instruction are more effective than those that focus directly on behavior, alone, because they focus more directly on the underlying causes of the problem. However, some participants in various seminars we have given about school effectiveness have suggested that improving discipline is a necessary first step. Some of these participants have been practitioners; others have been applied researchers. Perhaps there is a "breaking point" for behavior so that below that point one must first deal with behavior to reduce the chaos to a level where efforts to improve instruction can have some effect. Is this true? What is that breaking point?

TEACHER EXPECTATIO

In the brief discussion above of our theory of schooling, we emphasized that the crucial structural difference between effective and ineffective schools is the manner in which teachers form expectations. Rist (1973) in his case study of an urban elementary school suggests that teachers with low expectations for children have a bias (conscious or unconscious) against them and, therefore, give them less emphasis and less appropriate and intense instruction <u>even</u> when there is no perceived learning gap between expectations and achievement. Is this a widespread phenomenon? Indeed, has Rist described it accurately?

Expectations can rise, as McCormack-Larkin and Kritek (1982) have reported in Milwaukee. We hypothesized that teachers who perceive school-wide success in raising achievement will raise their expectations and give more weight to the belief that all but exceptional children can learn at or above grade level standards. What constitutes a perception of success for teachers? How long does it take a change in achievement patterns to change teacher expectations? And what happens if teacher expectations are higher than student achievement and there is no improvement over time? Do expectations erode? What factors accelerate or retard this erosion?

TEACHER DECISION MAKING FOR INSTRUCTION

Teacher expectations are of little importance if they do not influence the decisions teachers make about the delivery of instruction to students. We have argued in our theory that teachers adjust their emphasis on students and the appropriateness and intensity of instruction delivered in response to a perceived learning gap between expectations and achievement. This implies that past achievement is monitored and that information about achievement is used in diagnosis and planning. Is this true? Does teacher emphasis really vary with the perceived learning gap? How does this typically transpire phenomenologically?

In a heterogeneous classroom, teacher decisions about the emphasis to be placed on a given group of students cannot be made without considering the needs of the other groups in the class. No one group can receive all of a teacher's attention. How do teachers normally divide attention among groups? Does it depend on group size? Perceived need? How do teachers react when the total demands for attention exceed their capacity? Who wins or loses?

TEACHER EFFECTIVENESS

The fifth and final area for further research focuses on the role of teacher effectiveness in promoting school improvement. We see teacher effectiveness and teacher emphasis and time available for instruction as the three determinants of appropriateness and intensity of instruction for a given group of students. Teacher effectiveness focuses one's attention on understanding how teachers translate time available into time or task. How efficient are teachers with average skills in accomplishing this? What does it mean to speak of "average" skills? How does this efficiency vary with changing levels of skill? Does teacher effectiveness vary from group to group within a classroom? Why? If teacher effectiveness is thought of as the application of skills, what other factors mediate the relationship between skills and effectiveness?

We believe specific studies are needed to address questions like the ones we have raised above. Some aspects of these studies may be experimental in nature but other aspects, especially those which seek to describe effects on process may require ethnographic approaches to data collection and interpretation. Efforts to integrate findings across disciplines can be expected to excacerbate epistemological strains between experimental and more phenomenologically rooted paradigms. We believe that it will be increasingly necessary to explore innovative methods for interpreting, displaying, and examining inter-paradigmatic findings.

Utilizing "Alterable" Variables

The third of the four questions identified in the introduction to this paper concentrates on the link between theory and practice -- the identification of those school process and climate variables which represent potent forces for change. Our policy analysis and the work of others (c.f. Brookover, et al., 1979 and Edmonds, 1979) suggest that certain variables can have a significant impact on the level of effectiveness in a particular school.

In Figure 2, we indicated points of intervention in the system that through computer simulation policy analysis had demonstrated potential for ameliorating the problem of ineffective schools. From a systems perspective, each one of these points of intervention becomes the basis for a new negative feedback loop that can operate to control the level of the variable -- that is, to bring it in line with some desired value. As we mentioned before, the operation of a policy control loop requires that the goal be specified, that present conditions be monitored, and that actions be taken in response to a perceived discrepancy between the goal and the actual conditions.

For example, consider teacher skills. To mount a program for improving teacher skills, one must first know the present level of skill in the faculty and the level to which the skills are to be raised. The magnitude of the discrepancy indicates the type of intervention that might be needed. One cannot begin designing implementation strategies until baseline data are gathered and goals are set. This is precisely the strategy adopted by the State of Connecticut in its School Effectiveness Project.

The point we would like to emphasize here is that what variables one chooses to measure and the manner in which they are measured is directly dependent on the theory in which these variables are imbedded and the level of specificity of that theory. Our computer simulation model, the School Effectiveness Model, represents a highly specified theory of schooling. In the process of building the model we were forced to think about how to quantify and operationalize different variables. The model shapes the way we think about measuring school effectiveness.

Implementing Change Programs

Finally, there is in our judgment a vast and difficult domain of research which it seems crucial to do, or at least to begin to do at this time. Once the problem has been defined, the driving forces that generate the problem understood, and the points of intervention identified, one must grapple with how to structure and implement an effective change program. Our work and the work of many others has focused on the nature of effective schooling and on the critical differences between effective and ineffective schools. Our work has emphasized in particular the effects of feedback and has examined the dynamic qualities of these two types of schools. What is important about the work that has been done, and about the research agenda discussed above, is that it poses practical directions for improving schools. However, what it does not speak to are the problems of

implementing the changes which are necessary if these new directions are to be achieved.

We have already begun to discuss with a variety of individuals and foundations the importance of studying recent and ongoing efforts at systematic, planned school improvement. We must have a growing theory of effective schooling, one based on the mutual reinforcement of knowledge synthesis, theory building, and empirical research. We must also have a developing theory of the implementation of effective schooling, also based upon theory-guided research. Indeed, there can be no useful theory of effective schooling without a complementary theory of the dynamics of organizational change by which effective processes can be implemented in real schools.

We see the basic structure of this theory about the implementation of effective school programs as building upon the theory of schooling we have already developed. The points of contact are those points of intervention in the system where the principal or others might seek to influence the causal structure affecting student achievement. In our initial round of policy analysis, we assumed (tentatively, for purposes of simplicity) that an intervention, such as raising teacher expectations, would be successfully implemented. However, in reality, implementing school improvement policies has proven to be highly problematic (see, for example, Baldridge and Deal, 1975, Part III; Berman and McLaughlin, 1978; Gaynor, 1980; Goodlad, et al., 1971; Smith and Keith, 1971).

We would like to pursue further empirical research in schools that have made systematic efforts to improve. This research would attempt to elucidate the web of variables (e.g., staff motivation for change, conflict, staff workload, principal skill and time, political support, and resources) that influence the outcomes of implementation.

The proposed research would be informed by work already done in trying to understand the dynamics of innovation (and stability) in public schools. This work has developed some structural conceptions about the mutually reinforcing dynamics among external funding, leadership effectiveness, external linkage, and innovation. It has also explored the structural dynamics, especially those involving internal staff conflict and external political resistance, which limit innovation and stimulate the discontinuation of innovations once implemented. This work has included an empirical study seeking to clarify processes associated with the "life cycle" of a curriculum innovation in an elementary school (Gaynor, 1980), a study designed to examine empirically the phenomenology of the theoretical dynamics described in the Public School Change Model (Gaynor, 1979; 1981).

Summary

There has been historically in most schools a systematic difference in subsequent achievement between students who enter with average and low initial levels of learning readiness. Based on a comprehensive review of the extant literature on effective teaching and effective schooling, we have hypothesized that this widening gap is a function of the dynamic structure of the school.

A computer simulation model was described which depicts a crucial structural difference between schools which are effective and ineffective for initially low-achieving children. Ineffective schools operate for all children as "multipliers" of existing differences. This comes about because the quality of instruction, mediated largely by teacher expectations, varies directly with differences in student achievement. The result is that high achievers are systematically reinforced to do better and low achievers are systematically reinforced to do worse.

In contrast, schools which are effective for initially low-achieving students operate for these children as "thermostat systems." Teachers in effective schools define as problematic discrepancies between observed student achievement and grade level standards. Students whose achievement is below grade level standards are defined as "under-achievers" and efforts are made to improve the appropriateness and intensity of their instruction.

Based on an examination of the substance of this perspective on effective and ineffective schooling, and consistent with the view that important problems tend generally to be generated by the dynamic properties of feedback systems operating over time, some suggestions were put forward with regard to a research agenda on effective schooling. These included general suggestions about the crucial need for longitudinal research, theory-guided research, and for emphasis on knowledge synthesis and theory formulation as well as specific suggestions for research on substantive variables and relationships among variables. We also emphasized the need for research on the organizational dynamics of implementing school improvement programs.

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